Development and validation of a predictive model for microbial spoilage of ground meat

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Summary: The current philosophy for food quality assurance is steadily decreasing the focus on end product testing and verification, traditionally the cornerstones of quality and regulatory control. The efforts of producers and legislation is concentrating on the development and application of structured quality assurance systems based on prevention through monitoring, controlling and recording of critical parameters through the entire product's life cycle extending from production to final use. Effective application of this approach requires systematic study and modelling of the temperature dependence of shelf life. Ideally this would mean establishing a time correlation between measured microbiological activity and sensory value for the conditions of interest.

Methods: Microbiological and sensory changes of ground pork were monitored during aerobic storage at different isothermal temperature conditions from 0 to 15 °C). The growth data of spoilage bacteria from four individual replicated experiments with ground pork stored at different isothermal conditions were modeled as a function of time using the Baranyi model and the kinetic parameters (μ_{max}, Lag phase and N_{max}) were estimated. Further, the temperature dependence of the kinetic parameters was modelled using the Arrhenius equation. The models developed from the studies at isothermal conditions were validated at dynamic temperature conditions.

Results & Discussion: Pseudomonads were the dominant organisms of ground meat at all temperature testing following by *Br. thermosphacta*, lactic acid bacteria and *Enterobacteriaceae*. At all temperatures, growth of pseudomonads followed closely the decrease of sensory quality. End of shelf life coincided with an average level of 10^9 of pseudomonads within the studied range of temperatures. The activation energies were 75.3 και 73.4 kjoule/mol for the maximum specific growth rate and the lag phase of pseudomonads, respectively. The observed growth of the different spoilage bacteria at dynamic temperature conditions was compared with growth predicted by the Arrhenius model. Furthermore, the predicted shelf life (e.g time required for pseudomonads to growth from their initial level N_0 to the spoilage level $N_s=10^9$ cfu/g) was compared to the observed shelf life estimated by the sensory analysis. The results showed that the developed model predicted satisfactory microbial growth of pseudomonads on ground meat stored at both isothermal and dynamic conditions. The mean difference between observed and predicted shelf life at the dynamic temperature scenarios tested was 11%.

References:

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